Original paper

The impact of the COVID-19 pandemic on the number of patients presenting with appendicitis to the emergency department

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Abstract

Introduction: The COVID-19 pandemic has had an influence on the number of patients presenting to the emergency department (ED) with surgical conditions.

Aim: To evaluate the number of patients presenting with acute appendicitis (AA) and the percentage of complicated appendicitis before and after the COVID-19 disease outbreak.

Material and methods: This is a retrospective study based on the data of all patients presenting with AA to the ED of a tertiary COVID referral university hospital in Greece. We analysed the number of patients treated with AA, patient characteristics, and the proportion of patients with complicated appendicitis, and we compared the 2 groups of patients treated 12 months before and 12 months after COVID-19 onset in Greece.

Results: A total of 152 patients were included in this study. There was a significant decrease in the number of patients presenting with AA after COVID-19 onset in Greece. Respectively, 91 and 61 patients were subjected to appendectomy 12 months before and after COVID-19 onset. Comparing the 2 groups of patients, there was a statistically significant increase in the operation time ($p = 0.01$) after COVID-19 onset, whereas the percentage of complicated appendicitis, the duration of symptoms before presenting to the ED (< 24 h, > 24 h), and the type of operation (laparoscopic, open, converted) did not differ significantly between the 2 groups of patients.

Conclusions: The number of patients presenting to the ED with AA decreased after COVID-19 onset, most likely because patients hesitated to seek help in a COVID-19 referral hospital.

Introduction

On 26 February 2020 Greece confirmed the first COVID-19-positive case. With the economy recovering from a long period of recession, Greece only had 6 intensive care beds per 100,000 people available – one of the lowest rates among European Union countries. Therefore, strict pandemic restrictive measures were introduced early, and by 23 March 2020 the whole country was officially under curfew [1]. This stay-at-home mandate to lower the viral transmission as well as the patients' fear of being infected have been reported by many authors to result in decreased emergency general surgery consultations and in increased mortality due to the delay in seeking medical help [2].

Acute appendicitis (AA) is among the most common causes of acute abdomen, and surgery has been the most widely accepted treatment, with more than 300,000 appendectomies performed in the USA annually [3–5]. There is growing evidence that not all uncomplicated cases of appendicitis without treatment will lead to perforation [6]. Over the past years, there has been growing interest in non-operative management of uncomplicated appendicitis [4]. The COVID-19 pandemic has provided the ability to address the clinical challenge of nonoperative management of mild forms of appendicitis that would have been relatively difficult to evaluate under normal circumstance [7]. In the UK, Intercollegiate Guidelines were published to promote the non-operative management of AA and the avoidance

of laparoscopy when appendectomy is not mandatory [8]. The full impact of the COVID-19 pandemic on AA management is yet to be determined.

Aim

The aim of this study is to provide an overview of the impact of the COVID-19 pandemic on the presentation and management of AA at the emergency surgical department of a tertiary university COVID-19 referral hospital in Greece.

Material and methods

Data from all patients being admitted to the Surgical Department of the University General Hospital of Patras, Greece with the diagnosis of AA were extracted from the department's prospective digital database. All patients presenting to the emergency department (ED) with a diagnosis of AA at our hospital are generally treated with appendectomy, and we did not change our approach after the pandemic. The retrospective analysis included 2 groups of patients: the study group, which was subjected to appendectomy after COVID-19 onset in Greece (26 February 2020 – 26 February 2021) and the control group, which was operated on before COVID-19 onset (26 February 2019 – 25 February 2020).

Data analysis

We recorded demographic data and duration of symptoms until presenting to the ED (< 24 h, > 24 h). We also studied the operative reports and recorded the severity of appendicitis, classifying each case as simple (uncomplicated) or complicated based on the presence of perforation, abscess formation, or purulent peritonitis. Finally, we recorded the type of operation (laparoscopic, open, laparoscopic converted to open) and the duration of operation.

We compared the patient data between the study group (COVID, 26 February 2020 – 26 February 2021) and the control group (non-COVID, 26 February 2019 – 25 February 2020).

Statistical analysis

Statistical analysis was performed using the statistical package SPSS, version 22 (SPSS Inc., Chicago, IL, USA). We searched for differences between the 2 groups of patients using Pearson's χ^2 test for categorical variables and Student's *t*-test and the Mann-Whitney *U* test for continuous variables. Normality of data was either established or rejected by using the Shapiro-Wilks test and Q-Q plots of recorded data. Statistical significance was defined as a *p*-value < 0.05.

Results

A total of 152 patients presented to the ED with a diagnosis of AA during the reviewed periods. Sixty-one patients presented after the onset of COVID-19, and 91 patients presented in a similar time period before the onset of the pandemic. Thus, on an annual basis, the total number of patients presenting with AA during the COVID-19 pandemic significantly decreased by approximately 30% when compared with the previous year.

Ninety (59.2%) of the patients were males, 37 (41.1%) of whom underwent appendectomy during the study (pandemic) period and 53 (58.9%) during the control period. Sixty-two of the patients (40.8%) were females, 24 (38.7%) of whom underwent surgery during the study (pandemic) period and 38 (61.3%) during the control period. The mean age of our total sample was 38 years (range: 16–86), the mean age during the pandemic period was 37 years (range: 17–86), and the mean age of the control sample was 39 (range: 16–85). There were no statistically significant differences in demographic characteristics between the 2 groups.

Regarding the duration of symptoms until presenting to the ED, before the pandemic 30 out of 91 patients (33%) presented with symptoms > 24 h, whereas after the pandemic 22 out of 61 patients (36%) presented with symptoms > 24 h. There was no statistically significant difference in the duration of symptoms until the presentation to the ED between the 2 groups (p = 0.693).

Before COVID-19 onset 15.4% of patients (14 out of 91) had complicated appendicitis, whereas during the pandemic 19.7% of patients (12 out of 61) had complicated appendicitis. However, the difference between the 2 groups was not found to be statistically significant.

There was a statistically significant increase in the mean operation time after the COVID-19 pandemic, from 60 min (range: 25–180) before to 73 min (range: 25–165) after the pandemic (p = 0.01). There was no statistically significant difference in the proportion of open and converted to open appendectomies between the 2 groups (p = 0.642). The results of our analysis are summarized in Table I.

Discussion

The COVID-19 pandemic had a major impact on healthcare services. To preserve healthcare capacity for COVID patients and urgent non-COVID patients, elective surgical operations were postponed, and conservative treatments were proposed instead of surgery where possible. During the pandemic a significant reduction

Table I. Demographic, preoperative, and operative characteristics

Parameter		Total (*n* = 152)	Non-COVID (*n* = 91)	COVID (*n* = 61)	*P*-value*
Sex	Male	90	53	37	
	Female	62	38	24	
Age, median (range)		38 (16–86)	39 (16–85)	37 (17–86)	
Duration of symptoms until presenting to ED	< 24 h	100	61	39	0.693
	> 24 h	52	30	22	
Operation type	Laparoscopic	125	77	48	0.642
	Open	23	12	11	
	Conversion to open	4	2	2	
Appendicitis severity	Simple	126	77	49	0.491
	Complicated	26	14	12	
Operation time [min] median (range)		65 (25–180)	60 (25–180)	73 (25–165)	0.01

**The significance level is 0.05.*

in emergency surgery consultations was observed. In a recent systematic review and meta-analysis that examined the results of 46 suitable studies, the authors observed that during the pandemic AA cases in adults decreased by about 20%, complicated cases of AA increased, and there was an increase in antibiotic treatment therapy as well as in open procedures compared with laparoscopic [9]. Another recent systematic review and meta-analysis was recently published [10]. The authors collected data from 54 eligible studies, and they observed a decrease in hospital attendances for AA by 10% in adult patients as well as an increase in complicated cases. Other authors indicate that the incidence of complicated AA increased dramatically, with a 21% increase in perforated appendicitis and a 29% increase in gangrenous appendicitis as the intraoperative diagnosis [11]. The authors also state that in the studied population, during the studied period, there were not only curfew measures in effect, but also an official "stay at home" directive, regarding minor health issues. This also holds true for our studied period, and it is evidence that patients with minimal symptoms either did not seek medical attention until the appendicitis had progressed to a more serious clinical condition, or that they were successfully managed in an outpatient manner with antibiotic administration alone.

Treatment choice is another aspect recurring within the theme of emergency surgical conditions during the COVID-19 pandemic. Interestingly, there are few studies looking into conservative vs. surgical management of AA during COVID-19, and even more importantly, there is only one systematic report of recurrence rates of AA managed with antibiotics alone pre- vs. during COVID-19-related restrictions. A preliminary estimate of qualitative patient characteristics did not reveal any differences in the patient profile that is commonly selected for conservative management of appendicitis [12–14]. Two nationwide multicentric studies proved that conservative management with antibiotic administration was increased during the COVID-19 period, and regarding operative choices, open surgery was performed more often, possibly due to the complicated nature of the patients [15, 16].

Time to presentation was also recorded in some studies, and this was found to differ significantly in the COVID vs. pre-COVID period [9, 11, 17, 18]. Knowing that time from symptom onset to presentation is paramount in the occurrence of complicated appendicitis [19, 20], this also must be taken into account when examining literature data presenting with high rates of perforations or gangrenous appendicitis.

In accordance with the 2 aforementioned meta-analyses, in our retrospective single-institution study we also observed a reduction in the admission of AA patients by about 30%. Because seasonal changes have been reported as a factor affecting the incidence of AA, we chose to include in our study all patients admitted during the 12 months before and 12 months after COVID-19 onset in Greece [3]. Thereby, we minimized the potential impact of seasonal characteristics that may have affected AA incidence if we had chosen to compare 2 groups of patients from winter and summer months, respectively.

The reasons why adult AA cases decreased during the COVID-19 pandemic have been reported to be the stay-at-home policy that was proposed by the authorities of several countries, as well as the fear of viral infection of the patients that prevented them from seeking medical care. This resulted in a prolonged duration of symptoms until presentation to the ED, as well as

in increased cases of complicated AA [21]. However, in our study we did not observe any statistically significant differences in the duration of symptoms and the rate of complicated cases between the 2 groups of AA patients before and after the COVID-19 pandemic.

It should be noted that the specific circumstances related to each hospital and the population it serves play an important role in interpreting the results of single-institution studies. Our hospital is a tertiary university general hospital offering services to about 300,000 citizens annually. It is also a large COVID-19 referral hospital. Patients in Greece have the right to visit hospitals on duty irrespective of their postal address and without a letter from their general practitioner. Therefore, it is possible that AA patients may hesitate to visit COVID-19 referral hospitals even for their urgent medical conditions due to their fear of becoming infected with SARS-CoV-2. Therefore, larger multi-institutional studies are needed to further address this question.

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Ethics approval

11258/11/12/2022.

Conflict of interest

The authors declare no conflict of interest.

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